

Amendments to the Claims

This listing of the Claims will replace all prior versions and listings of the claims in this patent application.

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Listing of the Claims

Claims 1-91 (canceled)

10 92. (currently amended) A chip package comprising:

a substrate comprising a first pad having a surface with a first region, a second region and a third region between said first and second regions, and a solder mask layer on said first and second regions, wherein ~~and a first pad having a surface at a bottom of~~ a first opening in said solder mask layer is over said third region, and said

15 third region is at a bottom of said first opening;

a silicon chip over said substrate, wherein said silicon chip comprises a second pad having a surface with a first-fourth region, a second-fifth region and a third-sixth region between said first-fourth and second-fifth regions and over said third region, first pad, and a passivation layer on said first-fourth and second-fifth regions,

20 wherein ~~said third region is at a top of~~ a second opening in said passivation layer is under said sixth region, and said sixth region is at a top of said second opening;

a copper pillar between said third region and said sixth region, first pad, wherein said copper pillar is connected to said third region through said second-first opening and to said sixth region first pad through said first-second opening, and

25 wherein said second pad is connected to said first pad through said copper pillar;

a metal layer between said copper pillar and said third-sixth region, between said copper pillar and said passivation layer, between said copper pillar and said first-fourth region, and between said copper pillar and said second-fifth region, wherein said copper pillar is connected to said third-sixth region through said metal layer; and

30 a tin-containing layer between said copper pillar and said third region, first pad, wherein said copper pillar is connected to said third region first pad through said tin-containing layer, wherein said tin-containing layer comprises silver, and wherein

said tin-containing layer has a first thickness less than a second thickness of said copper pillar.

Claims 93-96 (canceled)

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97. (previously presented) The chip package of claim 92, wherein said copper pillar is electroplated.

Claim 98 (canceled)

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99. (previously presented) The chip package of claim 92, wherein said tin-containing layer further comprises copper.

Claim 100 (canceled)

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101. (previously presented) The chip package of claim 92 further comprising a conductive layer between said copper pillar and said tin-containing layer, wherein said second thickness is greater than a third thickness of said conductive layer.

20 Claims 102 and 103 (canceled)

104. (previously presented) The chip package of claim 92, wherein said tin-containing layer has a melting point less than that of said copper pillar.

25 Claim 105 (canceled)

106. (previously presented) The chip package of claim 92, wherein said metal layer comprises titanium.

30 107. (previously presented) The chip package of claim 92, wherein said metal layer comprises a titanium-tungsten alloy.

108. (previously presented) The chip package of claim 92, wherein said metal layer comprises chromium.

5 109. (previously presented) The chip package of claim 92, wherein said metal layer comprises copper.

Claims 110-117 (canceled)

10 118. (previously presented) The chip package of claim 92, wherein said tin-containing layer is directly on said copper pillar.

Claim 119 (canceled)

15 120. (currently amended) A bonding structure on a chip comprising a pad having a top surface with a first region, a second region and a third region between said first and second regions, and a passivation layer on said first and second regions, wherein an opening in said passivation layer is over said third region, and said third region is at a bottom of said opening, comprising:

20 a metal layer on said third region, over said passivation layer and over said first and second regions, wherein said metal layer is connected to said third region through said opening;

a copper pillar on said metal layer, over said passivation layer and over said first, second and third regions, wherein said copper pillar is connected to said third region through said metal layer; and

25 a tin-containing cap over said copper pillar, wherein said tin-containing cap is connected to said third region through said copper pillar, wherein said tin-containing cap comprises silver, and wherein said tin-containing cap has a first thickness less than a second thickness of said copper pillar.

30 121. (previously presented) The bonding structure of claim 120, wherein said tin-containing cap is directly on said copper pillar.

122. (previously presented) The bonding structure of claim 120, wherein said tin-containing cap has a greatest transverse dimension less than that of said copper pillar.

- 5 123. (previously presented) The bonding structure of claim 120, wherein said metal layer comprises titanium.

Claim 124 (canceled)

- 10 125. (previously presented) The bonding structure of claim 120, wherein said metal layer comprises chromium.

126. (previously presented) The bonding structure of claim 120 further comprising a conductive layer between said copper pillar and said tin-containing cap, wherein said
15 second thickness is greater than a third thickness of said conductive layer.

127. (previously presented) The bonding structure of claim 120, wherein said metal layer comprises a titanium-tungsten alloy.

- 20 128. (previously presented) The bonding structure of claim 120, wherein said metal layer comprises copper.

129. (previously presented) The bonding structure of claim 120, wherein said tin-containing cap has a melting point less than that of said copper pillar.

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Claims 130-150 (canceled)

151. (currently amended) A bonding structure on a chip comprising a pad having a top surface with a first region, a second region and a third region between said first and
30 second regions, and a passivation layer on said first and second regions, wherein an opening in said passivation layer is over said third region, and said third region is at a bottom of said opening, comprising:

a metal layer on said third region, over said passivation layer and over said first and second regions, wherein said metal layer is connected to said third region through said opening;

5 a copper pillar on said metal layer, over said passivation layer and over said first, second and third regions, wherein said copper pillar is connected to said third region through said metal layer; and

10 a tin-containing cap over said copper pillar, wherein said tin-containing cap is connected to said third region through said copper pillar, wherein said tin-containing cap has a first thickness less than a second thickness of said copper pillar, and wherein said tin-containing cap has a greatest transverse dimension less than that of said copper pillar.

15 152. (previously presented) The bonding structure of claim 151, wherein said tin-containing cap is directly on said copper pillar.

Claim 153 (canceled)

20 154. (previously presented) The bonding structure of claim 151, wherein said metal layer comprises titanium.

Claim 155 (canceled)

25 156. (previously presented) The bonding structure of claim 151, wherein said metal layer comprises chromium.

157. (previously presented) The bonding structure of claim 151, wherein said metal layer comprises copper.

30 158. (previously presented) The bonding structure of claim 151, wherein said tin-containing cap comprises silver and copper.

159. (previously presented) The bonding structure of claim 151 further comprising a conductive layer between said copper pillar and said tin-containing cap, wherein said second thickness is greater than a third thickness of said conductive layer.

5 160. (previously presented) The bonding structure of claim 151, wherein said metal layer comprises a titanium-tungsten alloy.

161. (previously presented) The bonding structure of claim 151, wherein said tin-containing cap comprises silver.

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162. (previously presented) The bonding structure of claim 151, wherein said tin-containing cap has a melting point less than that of said copper pillar.

15 163. (previously presented) The bonding structure of claim 120, wherein said copper pillar is electroplated.

164. (previously presented) The bonding structure of claim 151, wherein said copper pillar is electroplated.

20 165. (previously presented) The bonding structure of claim 120, wherein said tin-containing cap further comprises copper.